

# From Conscience and International Trade Law to Global Artificial Photosynthesis in the Sustainocene

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Beginning of the Journey: of human society and its ecosystem.  
International Law and Physics

This article sets out a story of how my interest in international law commenced at the ANU Law Faculty, continued into international trade law, and then into global artificial photosynthesis. It addresses issues about the ultimate sources of law and about the future of governance

As a student at what was then the ANU Law Faculty, my interests focused closely on what at first sight may seem the widely disparate fields of international law, conscience and meditation. With Andrew Byrnes, Vivienne Bath and Chris Erskine, I had been part of the first team from outside North America to win the



Jessup International Law Mooting competition. I meditated every morning during the competition and afterwards, while in the US, went off on a pilgrimage to Thoreau's Walden Pond near Concord, Mass. I won the prize for International Air and Space Law and wrote one essay for that course on the requirement for "high moral character" in the Secretary General of the United Nations and, considering the mystical side of Dag Hammarskjöld, whether that could be interpreted to require a level of contemplative attainment similar to that required in the Dalai Lama. My first job after law school was as associate to Mr Justice Lionel Murphy at the High Court of Australia, when one of the main cases concerned whether a dam on the wild Franklin River in Tasmania should be stopped – amongst other things, because it contravened legislation passed in compliance with an international environmental law treaty (the World Heritage Convention). After graduating in medicine and then becoming an academic at ANU, my interests moved to preventing the inclusion in the AUSFTA of the Australian Pharmaceutical Benefits Scheme (PBS) (one of the few pieces of public health policy supported by a majority of people in a majority of states in the 1948 Chifley constitutional referendum). I didn't know much about trade

agreements at that stage, but I had continued meditating every morning and I felt it kept me in tune in some way with conscience. It seemed very wrong to me that the corporations of another nation should, through the medium of a trade negotiation, strive to alter the governance requirements of another community, which referred to itself as a sovereign nation. That led me to my first Australian Research Council (ARC) Grant. Following conscience later helped me to get other grants on nanotechnology including an ARC grant on how nanotechnology could assist Australian and global public health.

### The Risk of Embracing Global Artificial Photosynthesis

Since I first started law school, academic and professional life seem really to be about critically examining the hypothesis that there is a field of consciousness behind the material world that will conspire with you help you discover what you're 'meant' to do, in terms of an altruistic 'calling.' The premise holds that knowledge is communicated through subtle coincidences that provide answers to profound questions presently being grappled with in your mind. Gradually I came to realise that as you kept following the lead provided by such coincidences and intuitions (many

of which arose during morning meditation) your mind identified more with the interests of others (as a type of 'wave function' in terms of physics). In fact it seemed that the true basis of both natural law and international law (the idealistic as opposed to the more positivist forms of law) was physics and concepts such as string theory in which the true equations of general relativity and those of quantum mechanics are joined in a universe of thirteen or more dimensions.

Once, when I was working on the UNESCO Global Health Law and Ethics database, I visited Namibia. In the Zebra River region of Namibia one can find fields of stone-age hand tools alongside much more ancient stromatolites. Stromatolites are the fossil remnants of cyanobacteria that were amongst the first photosynthetic organisms. They began creating oxygen on earth 2.5 billion years ago. At the time I had thought very little about photosynthesis. I had been doing neutron and light scattering experiments on nanoparticles with Prof John White's team at Lucas Heights and Grenoble. I'd told him I wanted to do something about the bigger issues of energy and climate change that humanity and its planet were facing; something to do with hydrogen and with carbon.

My first opportunity to review the ethical and legal aspects of artificial photosynthesis (AP) came at a 'Nanotechnology for Renewable Energy' conference at the foot of a glacier at Obergurgl in Austria. One morning, while wandering off from the presentations to the tea lounge, I met Prof. Peidong Yang from the University of California Berkeley. He told me he was awaiting the outcome of a large grant proposal to study artificial photosynthesis and believed he would solve the problem of developing a practical AP device within his lifetime. Peidong looked like a relatively young chap and I suggested that humanity did not have much time to wait. I suggested that the work would proceed faster if a large global project (like the Human Genome Project) could be established to foster collaboration amongst AP researchers across the world. He said "good idea, why don't you do something about it." This became the theme of my oral presentation the next day at Obergurgl, which was further elaborated in an oral presentation at the 15th congress of the International Society of Photosynthesis research in Beijing a few months later.

Photosynthesis is not only the source of our oxygen, but also, from absorbed carbon dioxide, food and basic fuels (including oil

(from decayed cyanobacteria in shallow oceans), coal and natural gas (from decomposed old forests)). Photosynthesis can be viewed as the planet breathing, although in a reverse way to us, taking in carbon dioxide and releasing oxygen. But it can also be considered as the planet's nervous system – generating a basic voltage that powers the world's life. This is because photosynthesis takes light energy from the sun and stores it in chemical bonds.

Photosynthesis, the ultimate source of our oxygen, food and fossil fuels, has been operating on earth for 2.5 GYr (1). More solar energy strikes the Earth's surface in one hour of each day than the energy used by all human activities in one year (2) (3). At present, the average daily power consumption for a citizen to flourish in life with a reasonable standard of living is about 125kWh/day. Much of this power is devoted to transport (~40 kWh/day), heating (~40 kWh/day) and domestic electrical appliances (~18 kWh/day), with the remainder lost in electricity conversion and distribution (4). World energy consumption is currently in the region of 450 EJ/yr, but the solar energy potentially usable is vastly more than this, at ~1.0 kilowatts per square metre of the earth –  $3.9 \times 10^6$  EJ/yr (5).

Photosynthetic organisms absorb

photons from various regions of the solar spectrum into chlorophyll molecules in thylakoids, or intracytoplasmic membranes; plants do the same in intracellular organelles called chloroplasts. A crucial component of this process is the oxygen-evolving complex (OEC) in a protein known as photosystem II (PSII) to split water ( $H_2O$ ) into hydrogen and oxygen. At the core of this process is the tetra-nuclear manganese/calcium cluster ( $Mn_4CaO_5$ ). The structure was recently characterised in a paper in *Nature* by Professor Kamiya and others at Osaka University to the level of 1.9 angstroms; showing that the cluster had a 'distorted chair' shape. Some of its components remain controversial, but such fundamental characterisation of the natural photosynthetic structure makes the scientific and commercial risks of attempting a wholly nanotechnologically-based structure much more feasible.

The electrons produced by sunlight-driven water splitting are captured in chemical bonds by photosystem I (PSI) to reduce NADP (nicotinamide adenine dinucleotide phosphate) for storage in ATP (adenosine triphosphate) and NADPH (nature's form of hydrogen). In the relatively less efficient 'dark reaction,' ATP and NADPH as well as carbon dioxide are used in the Calvin-Benson cycle

to make food in the form of three carbon sugars, then sucrose and starch via the enzyme RuBisCO.

In its present, technologically-unenhanced form, photosynthesis globally already traps around 4,000 EJ/yr solar energy in the form of biomass (6). The global biomass energy potential for human use from photosynthesis as it currently operates globally is approximately equal to human energy requirements (450 EJ/yr) (7) (8)(9).

Yet artificial photosynthesis (AP) is the subject of intense and advanced research by large groups of scientists in all developed nations (10). A dozen European research partners, for example, form the Solar-H network, supported by the European Union (11). The US Department of Energy (DOE) Joint Center for Artificial Photosynthesis (JCAP), led by the California Institute of Technology (Caltech) and Lawrence Berkeley National Laboratory, has US\$122m over 5 years to build a solar fuel system. Caltech and the Massachusetts Institute of Technology have a \$20 million National Science Foundation (NSF) grant to improve photon capture and catalyst efficiency, while several Energy Frontier Research Centers funded by the US DOE are focused on GAP-related endeavours

(12).

Natural photosynthesis is capable of substantial improvement with nanotechnology. It is estimated, for example, that even if 3000m<sup>2</sup> per person is devoted to it, biomass fuel from natural photosynthesis will indirectly (via intermediate energy carriers) contribute only 36 kWh/day per person (13). Photovoltaic energy systems are improving their efficiencies towards 25%, and the cost of the electricity they produce is nearing or has passed grid parity in many nations. But they are not an “off-grid” solution and so do not presumptively encourage new community-based governance patterns more likely to emphasize environmental sustainability. Even large solar farms (for example taking up 200 m<sup>2</sup> per person with 10%-efficient solar panels) could produce but ~50kWh/day per person (14). This is still a long way short of ~125 kWh/day average developed nation consumption and still leaves the problem of power storage for night use and transport. Clearly, if we are to make better use of the ratio of available solar energy to world annual energy consumption a better way to convert solar energy into fuel needs to be developed.

In the 1800s most people believed that only birds would ever fly, so they took risks to achieve that ideal

– attaching large artificial wings and jumping off cliffs. Likewise, most people today still believe that only plants or certain bacteria can “do” photosynthesis, so they take risks genetically engineering them. Yet imagine a world in which international law facilitates every house, road and vehicle on the surface of the earth performing photosynthesis better than plants.

I ended up coordinating the first international conference dedicated to creating a Global Artificial Photosynthesis (GAP) project, held in Australia on Lord Howe Island on 14-18 August 2011. As well as having endorsement from the UNESCO Natural Science Sector, it was an official event of the UNESCO 2011 International Year of Chemistry. Speakers included national and international experts in various aspects of artificial photosynthesis, such as photovoltaics, hydrogen fuel cells, quantum coherence in electron transfer and international governance systems. The UK Royal Society have funded me to coordinate a second such meeting at their rural retreat at Chicheley Hall in July 2014 (16).

Will Artificial Photosynthesis  
Become a Major Area of International  
Trade and Investment?

Artificially enhanced

photosynthesis, if applied equitably, could produce tradable products that assist crop production on marginal lands, reduce atmospheric CO<sub>2</sub> levels, lower geopolitical and military tensions over fossil fuel, food and water scarcity, and create carbon-neutral hydrogen fuel for domestic, community and industrial storage (17). One Global Artificial Photosynthesis (GAP) model involves bio-mimetic polymer photovoltaic generators plugged in to the national electricity grid to power hydrogen fuel and waterless agriculture, chemical feedstocks and polymers for fibre production (18). This model has the advantage of the ‘light’ and ‘dark’ reactions being uncoupled in relation not only to energy/material flow balance, but also to the requirement to be co-located in space. Such an uncoupling will vastly extend the area for capturing light over otherwise barren land, and also allow the elimination or reduction of molecular oxygen in GAP reactions, enhancing longevity of the components.

Another model emphasizes the greater potential for individual and community economic autonomy implicit in micro or local generation of fuel and food through GAP products installed as a policy priority on domestic dwellings and vehicles. Under such a model, large

GAP facilities providing fuel for industry or backup supply can still be preferentially located near large sources of seawater, CO<sub>2</sub>, waste heat, high solar irradiation, and in proximity to end use facilities.

Global promotion of AP (through its potential to reduce carbon dioxide) is directly relevant to the 2009 Copenhagen Accord – a non-binding political agreement that recognized the critical impacts of population growth and fossil fuel-driven climate change, as well as the need to establish a comprehensive adaptation program, including international support for those countries most vulnerable to its adverse effects (19). For the first time, all major CO<sub>2</sub>-emitting countries agreed to a target of keeping global warming to less than 2°C above pre-industrial levels. It contained important undertakings concerning mitigation, including the Copenhagen Green Climate Fund and establishing a mechanism to accelerate renewable energy technology development and transfer (20). Other important internationally agreed targets to reduce poverty and lack of necessary fuel and food are expressed in the United Nations Millennium Development Goals (21). These critical survival issues for the poor will be exacerbated as the global population grows towards 10 billion

by 2050 and energy consumption rises over 600 EJ/yr.

Many observers have derided such so-called ‘soft-norm’ (unenforceable and non-legally binding) agreements as facilitating a model for business-as-usual by the fossil fuel-related industries that are so central to energy supply and anthropogenic climate change. What if, however, science could provide in the next twenty years a means by which such goals and principles could be satisfied without compromising the capacity of people to obtain sufficient energy for survival and flourishing?

What if the global economy’s energy dependence on fossil fuels could be reduced as GAP products allowed buildings, cars, planes and ships to become producers of their own fuel? Economies would restructure to emphasize smaller locally-powered and controlled units, minimizing energy use in transportation (much present-day energy consumption is dedicated to gathering raw materials and low-cost labour to make and transport goods for use in other countries). Nanotechnology-based artificial photosynthesis systems might be programmed to remove carbon dioxide from the atmosphere in proportion as it was used in the burning of the produced ethanol,

or help coastal industrial plants split sea water using sunlight to produce carbon-neutral hydrogen-based fuels.

These thought experiments involve a future perspective in which solar fuels created through humanity's capacity to fully understand the principles and enhance (particularly through nanotechnology) the operation of photosynthesis, have become the predominant form of energy generation on the planet. Such micro or local generation of food and fuel will challenge the present paradigm of centralized fossil-fuel oriented power generation controlled by multinational corporations. It may not be an easy transition for them to manage and they may resist or try to delay the change to a GAP-fuelled world. International trade and investment law may provide them with a particularly useful mechanism in this regard.

Establishing the principles for the dissemination of GAP technology under international trade and investment law will be equally important as facilitating the scientific collaborations that will allow it to take place in time to address the major societal and environmental challenges that the expanding human population and its dependence on fossil fuels are

currently creating.

Societies, just as individuals, acquire virtues or character traits through the consistent application of principles in the face of obstacles (22). In the past those principles were predominantly a matter of philosophic and religious, as well as legislative and judicial debate. One hypothesis is that it should be statements on bioethics and human rights by international organizations such as the United Nations or UNESCO instead of international trade and investment law that consensually shape the principles applied in globally rolling out new technologies such as artificial photosynthesis.

'Soft-law' norms may be particularly valuable in this context. The United Nations Millennium Development Goals, for instance, have a high global symbolic resonance and democratic acceptance. They are particularly focused on issues of energy storage, production and conversion, agricultural productivity enhancement, water treatment and remediation, and experts have encouraged nanotechnology to systematically contribute to their achievement (23). Principles supporting similar goals (and directed to individuals, communities and private corporations and well as States (article 1)) appear in the



UNESCO Universal Declaration on Bioethics and Human Rights (particularly the social responsibility principle in article 14(b) –

‘access to adequate nutrition and water’, 14(c) – ‘improvement in living conditions and the environment’ and 14(e) – reduction in poverty and illiteracy’) (24).

### Governance of Global Artificial Photosynthesis and International Trade Law

There are high stakes for supranational corporations should the nanotechnology revolution begin to develop global artificial photosynthesis (GAP). Many global corporate entities may be concerned that GAP products will take financial and political power from their hands and return it to individuals and communities. Studies such as the Limits to Growth report confirm how the process of corporate profit-driven economic growth utilizing the structures of international trade and investment law is undermining the capacity of the biosphere to support the human species.

International trade, and more particularly international trade and investment law, lies at the heart of the corporate globalisation process by which foreign capital takes advantage of abundant natural resources (particularly timber,

oil, coal and minerals) or cheap labour, to manufacture products for distribution and profitable sale throughout the world using road, rail, sea and air freight transport, reduced tariffs and mass marketing techniques. If international trade in GAP products is to make a successful contribution to public and environmental benefit, then established thinking suggests it must be rolled out utilising this ‘free trade’ and corporate globalisation process.

International trade and investment law, which provides the rules governing the system of corporate globalisation, does not sit easily within established social contract, rule of law, or science-based natural law thinking. There are many reasons for this. One is that international trade and investment law is a normative scheme with a limited range of corporate-focused interests that do not cover the full range of human societal and environmental concerns. A second is that it represents law at the service of private corporate interests that has never emerged from protracted social contract thinking—its democratic legitimacy rests chiefly on an indirect link to the representatives of nation states who have rarely if ever sought a democratic mandate about its activities. The third is that

its governance mechanisms are not transparent or accountable to international 'civil society' or the rule of law. The discussion that follows highlights some important ways in which international trade and investment law may create obstacles to the successful international trade of GAP products.

The World Trade Organisation (WTO) is headquartered in Geneva near many of the United Nations human rights organisations with which it normatively has so little in common. The WTO is comprised of a secretariat and public officials from nation states who have been involved in agreements by which those states agree to not merely reduce various trade barriers, but to allow supranational corporations to take control of major national assets (such as intellectual property, hospital and health services, water, agriculture, power-generation and manufacturing) in a way that is very hard to undo (due to the compensation to corporate stakeholders that must be paid by taxpayers). What has been created, in other words, is a supranational corporation-controlled legal system that is pushing global governance in directions different to those of democratic-based community and civil society institutions committed to societal virtues such as justice, equity and, increasingly,

environmental sustainability.

One example of a WTO agreement that may create particular problems for the global roll-out of output from a macroscience NES project is the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). TRIPS is a pro-patent agreement likely to increase the price paid by governments, communities and citizens for nanotechnology-based products, by requiring increased patent terms and enhanced protection of patent monopolies under threat of trade sanctions. Its norms can be relied upon by corporate lobbyists to restrict the capacity for governments to issue compulsory licenses and mass-produce cheaper versions of patented GAP products in public health emergencies. The WTO General Agreement on Trade in Services (GATS) likewise allows small cliques of government trade officials (many of whom have been appointed from, and/or will subsequently be rewarded with, lucrative private sector employment) to 'liberalise' various health-related service areas (such as hospitals, electricity and water utilities) where GAP technology might be prioritized by governments. That privatization process is likely to diminish the likelihood that GAP technology will be speedily implemented in those

sectors, even if that is in the global public interest, if such a course would undermine the relevant corporate profits.

'Liberalise' is a word which draws on liberal ideologies of individual freedom, but in this WTO usage it appears to represent pro-corporate 'spin' to disguise a process that in effect facilitates the ownership of such services by foreign-based private corporations with little local accountability or motivation to reduce costs to citizens. Such WTO agreements have arisen despite considerable evidence against the public benefit of applying pro-privatisation, neo-classical economic theory to the health and environment sectors. Missing from such sectors, for example, are a genuinely competitive market, government capacity to regulate the market to prevent market failure, or the ability to accurately place a financial value on interests such as good health or a pristine environment.

Other WTO multilateral agreements potentially likely to create obstacles for GAP products include the Agreement on Agriculture (AoA), the Sanitary and Phyto-Sanitary Agreement (SPS) and the Agreement on Technical Barriers to Trade (TBT). In the period 1970-2000, in order to obtain leniency on national debt

repayments, many less developed nations were coerced into removing trade barriers via the Structural Adjustment Policies (SAPs) of the International Monetary Fund (IMF) and World Bank. SAPs were a practical manifestation of the so-called 'neoliberal political-economic consensus' that recommended deregulation of financial institutions and government technology regulators, so that free market forces could operate in more lucrative pro-monopolistic conditions.

In practice, neoliberal economic policy and SAPs entailed reductions of government expenditure on health, welfare, education and other public services; privatization of government enterprises and utilities; reducing government tax revenues; elimination of tariffs and subsidies (in practice for developing nations but not for protected agricultural industries in developed nations); undermining laws for minimum wages, collective bargaining, unfair dismissal and improved employment conditions, opening of capital and currency markets; removing barriers to foreign direct investment; and promotion of private property rights over natural resources and public goods. Such WTO policies, in other words cut across and even opposed policy initiatives and domestic legislation emerging out of established social

contact understandings predicated on foundational social virtues such as justice, equity and environmental sustainability. To the extent that GAP products may have a profound impact of developing nations economic situations and debt levels SAPs could have a major impact in either facilitating or inhibiting their roll-out.

WTO agreements do contain some recognition of public health and environmental norms that are likely to assist global roll-out of GAP products. Article 27.2 of TRIPS, for example, provides:

Members may exclude from patentability inventions, the prevention within their territory of the commercial exploitation of which is necessary to protect ordre public or morality, including to protect human, animal or plant life or health or to avoid serious prejudice to the environment.

Likewise article XIV of GATS provides:

...nothing in this Agreement shall be construed to prevent the adoption or enforcement by any Member of measures:

(a) necessary to protect public morals or to maintain public order;

See footnote 5

(b) necessary to protect human, animal or plant life or health;

(c) necessary to secure compliance with laws or regulations which are not inconsistent with the provisions of this Agreement including those relating to:

(i) the prevention of deceptive and fraudulent practices

Article XXb of the GATT (adopted in 1947 and incorporated into WTO Agreements in 1994) similarly allows an exception to GATT corporate privatisation rules when that is necessary 'to protect human, animal, or plant life or health.' Exceptions along these lines are now found in the Agreements on Application of Sanitary and Phytosanitary Measures (SPS agreements) and the Technical Barriers to Trade (TBT) agreement. The problem is that such considerations exist as difficult to justify exceptions, rather than considerations equally important as core international trade law concepts such as 'liberalisation' (which can be translated as 'open-access to social control by supranational corporations').

To give an example, in 1988 the European Union (EU) imposed a ban on the sale of beef from cattle fed with artificial hormones following the precautionary principle and

evidence that this could cause cancer or nerve disorders. The US challenged the decision in 1996 and a WTO panel of trade lawyers ruled the ban was illegal (against the restricted set of WTO norms they apply) chiefly because it was inconsistent with the SPS agreement and its risk-assessment procedures.

More recently, United States-based corporations have been instrumental in inducing the US Trade Representative (USTR) to negotiate a series of regional and bilateral Free Trade Agreements (FTAs) in which provisions are included increasing intellectual monopoly privileges (IMPs), promoting investor-state dispute settlement mechanisms and pressuring health-technology cost-effectiveness assessment systems in ways not possible in the WTO (where the bargaining power of the US is countered by opposing blocks of developing nations). These mechanisms too could become obstacles to global roll-out of GAP products.

The United States has a long history of using trade law to influence health and environmental policies in other nations to the benefit of its corporations. In 1988, for example, an amendment called 'Special 301' was made to a section of the Trade Act 1974 (US). This became

the principal statutory authority under which the US investigated and, if need be, threatened trade sanctions against foreign countries that maintained acts, policies and practices that its corporations considered violated, or denied their rights or benefits under trade agreements, or, though otherwise being justifiable, reasonable or non-discriminatory, nonetheless burdened or restricted US commerce. The USTR was required under the Trade Act 1974 (US), to create, in its annual review, a Special 301 Report Priority Watch List. Using this mechanism corporations could petition the USTR to investigate and, ultimately, threaten trade sanctions against what they perceive to be an unjustifiable, unreasonable or discriminatory policy related to utilization of GAP products by a foreign country (for example a subsidy for GAP products that were competing in the market against existing patented products).

The capacity of US bilateral trade agreements to undermine global marketing of GAP products is highlighted by their use to attempt to alter public-focused regulatory processes such as quarantine, blood fractionation, safety and cost-effectiveness assessment of health technologies. A World Health Organization (WHO) commission and numerous civil society

publications have documented the contradictory relationship of such provisions with the Doha Declaration on TRIPS and Public Health and their potentially deleterious impacts on public health.

The tactics that might be employed by supranational companies in connection with trade agreements to preferentially alter domestic governance arrangements concerning GAP products are both multitudinous and morally questionable for not being capable of universal application and lacking coherence with global or domestic social contracts. Apart from specific provisions increasing intellectual monopoly privileges, they may include revolving door appointments (between private interest lobby groups and the USTR trade offices) and 'working groups' established under bilateral and regional trade agreements to lobby for and block domestic governance changes in the other signatory nations.

### Global Artificial Photosynthesis and Investor-State Provisions

Another tactic of particular concern as a potential obstacle to global roll-out of GAP products are attempts by supranational corporations to influence global governance regimes by means of so-called 'investor state'

dispute settlement provisions. In the 1990's, civil society prevented the creation of a supranational investment protection agreement (the Multilateral Agreement on Investment or MIA) that would have allowed the global implementation of such provisions, but they have nonetheless proliferated in a series of bilateral and regional arrangements. Basically, they allow supranational corporations to sue (before small panels of commercial arbitration lawyers with little understanding of or desire to apply international public law) other nations who have imposed governance requirements (even when in the public health and environmental interest based on good scientific evidence) if their commercial interests are thereby impeded.

Investor-state provisions surfaced in the failed Multilateral Investment Treaty (MAI) in the 1990's and in the 1994 North American Free Trade Agreement (NAFTA) between the United States (US), Canada and Mexico (25). They are now part of over 2000 bilateral investment treaties (BITs) (26). They grant investors covered by them a right to initiate dispute settlement proceedings (before a panel of trade lawyers known as commercial arbiters) for damages against foreign governments in their own right (27).

The lawyers officiating on such arbitral proceedings view such investment agreements as private contracts, are paid by the parties and do not necessarily take account of domestic public health and environment protections – creating a pro-investor jurisprudence. It should be of concern to those supporting marketing of GAP products that investor-state challenges have occurred in relation to a broad spectrum of public health and the environment legislation and policies. Supranational corporations could use this mechanism to claim compensation where a global NES project was subsidised by a government on the basis that its products were more environmentally friendly or safe from a public health point of view. Statutes on water protection, waste disposal and waste treatment as well as universal health care and access to affordable medicines have been challenged by supranational corporations under investor-state mechanisms.

Should GAP products begin to look as if they are likely to replace those upon which supranational corporations have substantial investments (in say old photosynthesis fuels or electricity distribution networks), then those corporations may well resort to

investor-state mechanisms to protect their profits and inhibit the roll-out.

The investor-state legal mechanism sits in a twilight zone between international public law (including international human rights law) and commercial arbitration. In Philip Morris's investor-state claim against Australia one of the lawyers will be chosen by Philip Morris. That company will undoubtedly choose a commercial arbitrator who views the issues through the narrow vision of contractual rights. This results, for example, in the appointment of a lawyer likely to view sovereign states as having no capacity to issue interpretive declarations of their intentions under the treaty (as would normally be the case under international public law). The United States has never lost an investor-state dispute settlement claim (28).

Australia can choose another member of the panel, but this might often be done through the agency of a private legal firm that doesn't appreciate the importance of ensuring a lawyer is appointed with public law expertise. Each party then chooses the president of the panel who has the deciding vote. It will be important but difficult for Australia to get a lawyer with a public law background into that role.

Investor-state provisions have been criticised as allowing foreign investors leverage to undermine government legislation promoting, for example, sustainable development, environmental protection, and public health policy (29). Investor-state dispute settlement claims have challenged attempts by nation states to regulate against chemicals proven to cause developmental disability (30), neurotoxins (31), hazardous lawn pesticides (32) and carcinogenic gasoline additives (33). The mechanism has also been used by foreign corporations to attempt to overturn legislation on water security (34), waste disposal (35), waste treatment (36) and a US ban on cattle with suspected bovine spongiform encephalopathy (BSE or mad cow disease) (37).

The Australian Productivity Commission's final report in December 2010 recommended that the government should seek to avoid the inclusion of investor-state dispute settlement provisions in its trade agreements. The Commission found against the need for such provisions because of the desire on the part of governments to retain a good reputation with foreign investors, the lack of systematic regulatory bias against foreign investors, the availability of insurance and investor-state

contracts as well as the "considerable policy and financial risks" arising from them (38).

The Australian government signalled that it did agree with the inclusion of investor-state dispute settlement provisions in the TPPA, though this was probably one of the main reasons the TPPA was initiated by the US. In a published letter responding to an opinion editorial piece (by the author and a colleague) about the inclusion of investor-state provisions in TPPA, Australian Trade Minister Simon Crean wrote:

Let me say we have serious reservations about the inclusion of investor-state dispute settlement provision in this agreement. We do not want new layers of red tape under the guise of trade liberalization. Australian negotiators will make this clear at the Melbourne meeting which concludes today." (39)

In 2011 the Australian Government went further and announced in a Trade Policy Statement:

Some countries have sought to insert investor-state dispute resolution clauses into trade agreements. Typically these clauses empower businesses from one country to take



international legal action against the government of another country for alleged breaches of the agreement, such as for policies that allegedly discriminate against those businesses and in favour of the country's domestic businesses... The Gillard Government supports the principle of national treatment — that foreign and domestic businesses are treated equally under the law. However, the Government does not support provisions that would confer greater legal rights on foreign businesses than those available to domestic businesses. Nor will the Government support provisions that would constrain the ability of Australian governments to make laws on social, environmental and economic matters in circumstances where those laws do not discriminate between domestic and foreign businesses. The Government has not and will not accept provisions that limit its capacity to put health warnings or plain packaging requirements on tobacco products or its ability to continue the Pharmaceutical Benefits Scheme.

In the past, Australian Governments have sought the inclusion of investor-state dispute resolution procedures in trade agreements with

developing countries at the behest of Australian businesses. The Gillard Government will discontinue this practice. If Australian businesses are concerned about sovereign risk in Australian trading partner countries, they will need to make their own assessments about whether they want to commit to investing in those countries.

Foreign businesses investing in Australia will be entitled to the same legal protections as domestic businesses but the Gillard Government will not confer greater rights on foreign businesses through investor-state dispute resolution provisions. (40)

Since the election of a conservative government in 2013, this policy has changed. A trade agreement has been signed between Australia and South Korea which contains an ISDS provision and some 'carve outs' for health and the environment. It is likely that this will be the approach of the Australian government to ISDS in the TPPA (41). This, combined with a raft of privatisation measures driven by the National Commission of Audit (NCA) could see a massive haemorrhaging of sovereignty in favour of multinational corporations and several steps taken towards Australian citizens becoming corporate –serf-consumers in their

own land.

## International Public Law and Photosynthesis as Planetary Common Heritage

A GAP Project governance structure emphasizing international law might protect photosynthesis from excessive patents promoting inequitable or unsustainable use within the class of United Nations treaties involved with protecting the common heritage of humanity (such provisions cover, for instance, outer space (42), the moon (43), deep sea bed (44), Antarctica (45) and world natural heritage sites (46)). Five core components are generally regarded as encompassing the common heritage of humanity concept under public international law. First, there can be no private or public appropriation; no one legally owns common heritage spaces or materials. Second, representatives from all nations must manage such resources on behalf of all (this often necessitating a special agency to coordinate shared management). Third, all nations must actively share with each other the benefits acquired from exploitation of the resources from the commons heritage region, this requiring restraint on the profit-making activities of private corporate entities and linking the concept to that of global public good.

Fourth, there can be no weaponry developed using common heritage materials. Fifth, the commons should be preserved for the benefit of future generations (47)(48).

The claim for GAP and its core components to common heritage status would likely be at an inchoate stage initially. Probably the closest analogies involve claims that genetic diversity of agricultural crops (49), plant genetic resources in general (50), biodiversity (51) or the atmosphere (52) should be treated as not just areas of common concern but subject to common heritage requirements under international law. The non-binding UNESCO Universal Declaration on the Human Genome and Human Rights, for example, only goes so far as to declare in Article 1 that: "The human genome underlies the fundamental unity of all members of the human family, as well as the recognition of their inherent dignity and diversity. In a symbolic sense, it is the heritage of humanity." Article 4 states: "The human genome in its natural state shall not give rise to financial gains" (53). Other international law concepts that could be influential are those that may declare GAP a global public good (54), an aspect of technology sharing obligations (55), or those arising under the international right to health (set out for example

in article 12 of the United Nations International Covenant on Civil and Political Rights)(56). The UNESCO Declaration on the Responsibilities of the Present Generations Towards Future Generations expresses a concept of planetary common heritage that could encompass GAP in article 4:

The present generations have the responsibility to bequeath to future generations an Earth which will not one day be irreversibly damaged by human activity. Each generation inheriting the Earth temporarily should take care to use natural resources reasonably and ensure that life is not prejudiced by harmful modifications of the ecosystems and that scientific and technological progress in all fields does not harm life on Earth. (57)

Planetary medicine is now a growing field in which the expertise of medical professionals is directed towards issues of global health and environmental protection, particularly including climate change (58). A GAP Project could well be promoted through domestic and international media as a defining symbolic endeavour of planetary nanomedicine (59) (60). One benefit of this for artificial photosynthesis researchers is that

funding agencies respond indirectly to public and governmental national interest concerns and nanotechnology, despite its great promise, still has a problematic place in the popular imagination owing to safety issues. A GAP Project therefore represents an excellent opportunity to create high-profile awareness of nanotechnology as a positive contributor to overcoming major contemporary public health and environmental problems.

The process of photosynthesis is as central to life on earth as DNA; thus there are likely to be similar major debates over whether patents should be allowed over any part of the photosynthetic process. Such a debate will be unlikely to inhibit patents being taken out over many aspects of GAP. The US Supreme Court, for example, has ruled that genes (despite the symbolic importance of DNA to human heritage) can be patentable if they are isolated and purified (61).

GAP research and development will also face major issues about whether patents should cover GAP products as well as processes and functions (62). It is likely that in the US the 'utility' for a GAP patent (as is the case for DNA) will be that it must be specific, substantial and credible (63). If GAP IMP ownership becomes fragmented, researchers

in the field may find their 'follow-on' research hampered by the high cost and difficulty in negotiating contracts with large numbers of GAP IMP owners. Each individual GAP patent owner, for example, without some prior licensing and sharing arrangement, will have an incentive to overcharge other researchers requiring access (64).

### Conclusion

Global artificial photosynthesis could replace globalisation as an unsustainable model of perpetual economic growth at the service of multinational corporations. This could transform the current model in which citizens are made serf-debtors to corporations upon graduation from university, upon buying a house with a mortgage and through having their superannuation gambled on the stock exchange. In such an anthropocene world people exist like tread mill rats frantically running round and round from brief job till next part-time brief job in fear of debt and naively believing their vote will bring change or that their capacity to make choices in a supermarket (the corporate globalisation outer circle of hell) equates with democratic responsibilities.

In the coming epoch known as the Sustainocene (which must

last a billion years if humanity is to repay its debt to evolution and earn a status as an ethical species) economies might restructure to emphasise smaller locally-powered units, minimising the energy used in gathering raw materials and low-cost labour to make and transport goods for use in other countries. In the Sustainocene international law will be replaced by global law representing people rather than facilitating, as it does now, the rule of law being hijacked by oligarchies in the name of nation states (under the fiction that they represent the will of the people) and their special interest corporate clients. Electronic communication will allow direct citizen participation in democratic processes locally and globally to a much greater extent. Corporations of a certain size will be required to be 'married' each year to nominated public goods as a condition of registration under corporations law. A world powered by artificial photosynthesis will be much closer to being ecologically sustainable as a foundation for society valuing contemplation in the elderly and the 'Copernican' revolution in consciousness (to realise the paradoxical truth that it has a wave function existing outside the physical form as well as a particle function within its brain). Moving towards environmental sustainability as a non-

anthropocentric foundational social virtue alongside justice and equality is a jurisprudential investigation I find very challenging. The next generation of legal and political leaders will need to stay idealistic and optimistic about humanity's future if this transformation is to occur. One of my inspirations in this regard is the tank commander Oddball in 'Kelly's Heroes.' Oddball's favourite line when faced with a bleak and hopeless scenario is "don't hit me with them negative waves. Have a little faith, man. Have a little faith." To get to the Sustainocene from these bleak and destructive times we all need a bit of faith in humanity's destined moral role as a good steward over the planet.

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# Legalise Torture?

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## Introduction

The first decade of the 21st century has been labelled 'the age of torture' (1). Yet Mirko Bagaric argues that there is 'not enough official torture in the world' (2). He considers the 'absolute prohibition against torture morally unsound and pragmatically unworkable' (3) and that 'torture is morally defensible, not just pragmatically desirable' (4). This article will disprove this argument, and contextualise the discussion within the wider framework of the positive/natural law debate in human rights law to show that the absolute prohibition of torture reflects natural law theories of human rights, is morally

sound, pragmatically workable, and should be upheld under all circumstances. This article will highlight the legal, moral and practical issues surrounding support for official torture by considering moral arguments surrounding the legalisation of torture, critiquing utilitarian calls for its legalisation, highlighting problems with regulation of torture and finally discussing the slippery slope argument.

## Background

### Definition

The Convention Against Torture and Other Cruel, Inhuman or Degrading

